Simpson

INSTRUMENTS THAT STAY ACCURATE

OPERATOR'S MANUAL

MODEL 260

VOLT-OHM-MILLIAMMETER

SIMPSON ELECTRIC COMPANY

5200 W. Kinzie St., Chicago 44, Illinois, Col. 1-1221

In Canada, Bach-Simpson, Ltd., London, Ontario

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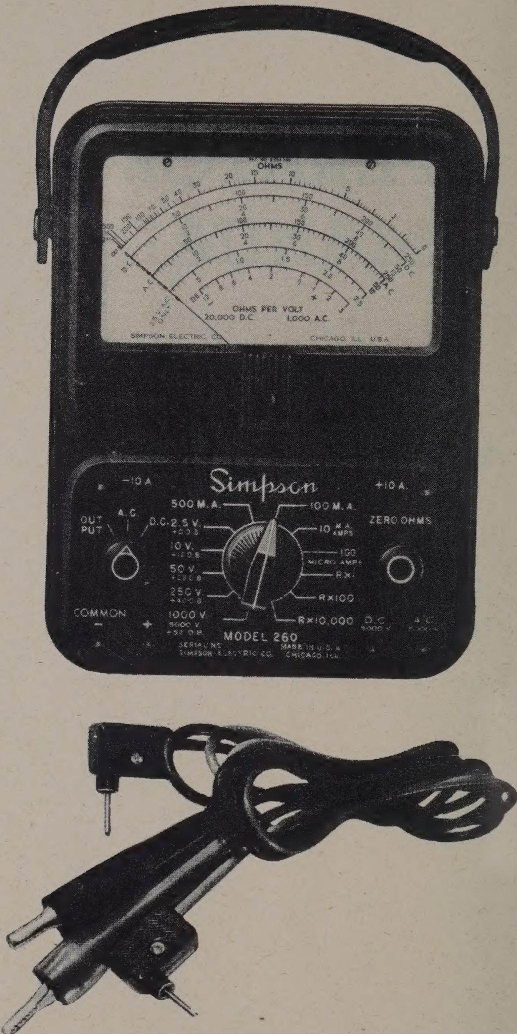


Figure 1 Simpson Model 260 Volt-Ohm-Milliammeter

Size: 5-1/2"x7"x3-1/4". Weight 3-1/4 lbs.

TABLE OF CONTENTS

SECTION VI SUPPLEMENTARY DATA

LIST OF ILLUSTRATIONS

Foreword

As the purchaser of a Simpson 260, you are now the owner of the most famous testing instrument in the world. Compact, of unusually high sensitivity (50 microamperes full scale), the Model 260 has earned its top-ranking reputation as the result of quality construction joined to exceptional engineering versatility. This engineering superiority is, in turn, the product of invaluable years of experience with every single unit comprising the complete assembly.

In choosing the Simpson 260, you have concurred in the verdict of over 300 government agencies and university laboratories which, long before World War II, and all through it, purchased it in quantities unequalled by any competitive instrument. It served on every battlefront and in every branch of our armed services.

In no other instrument of its kind do you find features such as are contained in the Simpson Model 260. Its trim, scientific appearance -- the 4-1/2" modernistic instrument, the heavy bakelite case, the neat bakelite panel -- gives evidence of inner quality. These hidden features are too numerous to mention here, but your pride in your new instrument will grow as you learn of them. Parts are assembled and placed in position so they cannot become loose or detached from their original positions. All the sub-assemblies are mounted on specially designed bakelite panels, or on a specially designed sub-panel, made and engineered expressly for a specific function in the Model 260.

When you purchase Simpson test equipment, you get equipment made almost entirely within the various plants of our Company. Each component part of the 260 has been designed and completely tooled and manufactured in our own plants, with the exception of the resistors and one or two other functionally less important parts. The Model 260, like all other Simpson

testers, is not an assembly job made up from purchased parts such as is true of the majority of testers offered on the market.

We are by far more self-contained than any other manufacturer of test equipment. This is your assurance that the testers we offer will not quickly become obsolete. Our tremendous investment in expensive production tools is your safeguard against obsolescence and further assurance of unvarying quality.

Here at Simpson we do not think of making instruments merely to sell. We think of making instruments to serve. Our interest in your Model 260 and in your satisfaction with it never ceases. That is the reason for this Operator's Manual. We want you to know how to get the most from your 260.

The Model 260 is a rugged instrument and will withstand a great deal of abuse. We urge you, however, to treat it with care as its mechanism is actually more delicate than that of a watch. If you will keep it clean, free from continuous, severe vibration and avoid dropping it, your Model 260 will give you a lifetime of accurate, dependable service.

OPERATOR'S MANUAL

SIMPSON MODEL 260 VOLT-OHM-MILLIAMMETER

SECTION I

GENERAL DESCRIPTION

1. GENERAL INTRODUCTION.

The Simpson Model 260 Test Unit offers the service dealer a small, compact and complete instrument with high sensitivity for testing and locating trouble in all types of circuits. The large four and one-half inch meter provides a long scale that is easy to read and the compact arrangement of the controls allows the overall size of the bakelite housing to be comparatively small for maximum portability.

Each unit is supplied with an operator's manual and one set of red and black test leads with insulated clips.

The electrical circuit is designed to give maximum insurance against inaccuracy and damage to the component parts. Highly accurate carbofilm resistors are used to insure long life and dependability and these are firmly held in place in a special bakelite housing designed for this purpose. The entire assembly is truly rugged and can well withstand the wear and tear of the service work for which it is designed. Accuracy is 3% D.C. and 5% A.C. of full scale deflection.

2. MEASUREMENT RANGES AVAILABLE.

a. D. C. VOLTAGE

0-2.5 volts	20,000 ohms per volt sensitivity
0-10 volts	
0-50 volts	
0-250 volts	
0-1000 volts	
0-5000 volts	

b. A. C. VOLTAGE.

0-2.5	volts	1,000 ohms per volt sensitivity
0-10	volts	
0-50	volts	
0-250	volts	
0-1000	volts	
0-5000	volts	

c. A. F. OUTPUT VOLTAGE.

0-2.5	volts	.1 Mfd. internal series condenser
0-10	volts	
0-50	volts	
0-250	volts	
0-1000	volts	

d. VOLUME LEVEL IN DECIBELS.

-12 to + 3 decibels	Calibrated for use across a 500 ohm line
0 to +15 decibels	
+14 to +29 decibels	
+28 to +43 decibels	
+40 to +55 decibels	

e. D. C. RESISTANCE.

0-2000 ohms	(12 ohms center)
0-200,000 ohms	(1200 ohms center)
0-20 megohms	(120,000 ohms center)

f. CURRENT IN D. C. CIRCUITS.

100 microamperes	250 millivolts
10 milliamperes	
100 milliamperes	
500 milliamperes	
10 amperes	

3. D. C. VOLTAGE MEASUREMENTS.

D. C. voltage is measured by applying the unknown voltage to the meter through suitable internal series resistors. The meter has a full scale sensitivity of 50 microamperes at 100 millivolts with an internal resistance of 2,000 ohms, giving the instrument an overall sensitivity of 20,000 ohms per volt.

4. A. C. VOLTAGE MEASUREMENTS.

A. C. voltage measurements, including output and decibel readings, are made possible by the use of an internal copper oxide rectifier connected in series with the meter. A precision wound internal shunt resistor is connected in parallel with the meter in order to obtain a sensitivity of 1,000 ohms per volt.

5. D. C. RESISTANCE MEASUREMENTS.

D. C. resistance measurements are made by employing an internal battery and precision series and shunt resistors, resulting in accurate indication of resistance value.

6. CURRENT MEASUREMENTS IN D. C. CIRCUITS.

Current is measured through the use of precision internal shunts resulting in accurate indication throughout the various ranges.

SECTION II

OPERATING INSTRUCTIONS

CAUTION: When making measurements, turn off the power to the circuit under test, clip the test leads to the desired points and then turn on the power to take the reading. Turn off the power to disconnect the meter.

ZERO ADJUSTMENT: Before taking readings, be sure that the pointer is on zero. If pointer is off zero, adjust by means of the slotted screw located in the bakelite case directly below the meter scale as shown in Figure 1. Use a small screw-driver to turn this adjustment slowly to the right or left until the pointer is directly over the zero point on the scale.

1. D. C. VOLTAGE MEASUREMENTS 0-1000 VOLTS.

a. Place the "OUTPUT-A.C.-D.C." switch in the "D.C." position.

b. Rotate the range selector switch to any one of the voltage positions required. WHEN IN DOUBT OF THE VOLTAGE PRESENT, ALWAYS USE THE HIGHEST RANGE AS A PROTECTION TO THE METER. After obtaining the first reading, the switch can be reset to a lower range, if needed, to obtain a more accurate reading.

c. Plug the black test lead into the jack marked "COMMON--" and the red test lead into the jack marked "+". Clip the other end of the black lead to the negative side of the circuit to be checked and the other end of the red lead to the positive side.

d. Turn on the power to the circuit to be tested. If the pointer deflects to the left of zero, the connections are incorrect. Turn off the power and reverse the position of the test clips.

e. Read the voltage on the black arc marked "D.C." which is second from the top.

For the 2.5 volt range use the 0-250 figures and divide by 100.

For the 10, 50 and 250 volt ranges, read the figures directly.

For the 1000 volt range, use the 0-10 figures and multiply by 100.

2. D. C. VOLTAGE MEASUREMENTS 1000-5000 VOLTS.

CAUTION: Use extreme care when checking high voltage. Always turn off power before making connections and do not touch meter or test leads while taking the reading.

a. Place the "OUTPUT-A.C.-D.C." switch in the "D.C." position.

b. Set the range selector switch in the 1000 volt position.

c. Plug the black test lead into the jack marked "COMMON--" and the red test lead into the jack marked "D.C. 5000 V."

d. Be sure power is turned off to the circuit to be tested and the condensers are discharged; then clip the black test lead to the negative side and the red test lead to the positive side.

e. Turn on the power.

f. Read the voltage using the 0-50 figures on the black arc marked "D.C." which is second from the top, then multiply the reading by 100. Turn off power before disconnecting meter.

3. A. C. VOLTAGE MEASUREMENTS 0-1000 VOLTS.

a. Place the "OUTPUT-A.C.-D.C." switch in the "A.C." position.

b. Rotate the range selector switch to any of the five ranges required. WHEN IN DOUBT OF THE VOLTAGE PRESENT, ALWAYS USE THE HIGHEST RANGE AS A PROTECTION TO THE METER. After obtaining the first reading the switch can be reset to a lower range for a more accurate reading.

c. Plug the black test lead into the jack marked "COMMON--" and the red test lead into the jack marked "+". Clip the other ends of the test leads to the two sides of the circuit to be tested. A.C. voltage will read correctly regardless of which way the test leads are connected.

d. Turn on the power to the circuit to be tested.

e. For the 2.5 volt range, read the voltage on the red arc marked "2.5 V. A.C. Only." which is second from the bottom.

For the other ranges use the red arc marked "A.C." which is third from the bottom.

For the 10, 50 and 250 volt ranges, read the figures directly.

For the 1000 volt range read the 0-10 figures and multiply by 100.

4. A. C. VOLTAGE MEASUREMENTS 1000-5000 VOLTS.

CAUTION: High voltage is dangerous. Always turn off power when connecting or disconnecting test leads. Do not handle meter or test leads while power is on.

a. Set the "OUTPUT-A.C.-D.C." switch in the "A.C." position.

b. Rotate the range selector switch to the 1000 v. position.

c. Plug the black test lead into the jack marked "COMMON--" and the red test lead into the jack marked "A.C. 5000 V."

d. Be sure power is turned off in circuit to be tested and then clip the test leads to the two sides of the circuit. A.C.voltage will read correctly regardless of which way the leads are connected.

e. Turn on the power.

f. Read the voltage on the red arc marked "A.C." which is third from the bottom. Use the 0-50 figures and multiply by 100. Turn off power before disconnecting meter.

5. A. F. OUTPUT MEASUREMENTS.

a. Place the "OUTPUT-A.C.-D.C." switch in the "OUTPUT" position. When the switch is in this position an internal condenser is connected in series for the purpose of blocking out the D.C. component whenever connections are made directly to the plate of a tube.

b. Rotate the range selector switch to any of the five ranges required. WHEN IN DOUBT OF THE VOLTAGE PRESENT, ALWAYS USE THE HIGHEST RANGE AS A PROTECTION TO THE METER. After obtaining the first reading, the switch can be reset to a lower range for a more accurate reading.

c. Plug the black test lead into the jack marked "COMMON--" and the red test lead into the jack marked "+". Clip the other ends of the test leads to the output of the circuit under test.

d. Turn on the power.

e. For the 2.5 volt range use the red arc marked "2.5 V. A.C. only" which is second from bottom.

For the other ranges, use the red arc marked "A.C." which is third from the bottom.

For the 10, 50 and 250 volt ranges, read the figures directly. For the 1000 volt range, use the 0-10 figures and multiply by 100.

The reactance of the series condenser used when reading output volts causes a slight error which varies with frequency. This is explained in paragraph 3 of Section III.

6. VOLUME LEVEL MEASUREMENTS.

a. Set the "OUTPUT-A.C.-D.C." switch in the "A.C." position.

b. Rotate the range selector switch to any of the five ranges required.

c. Plug the test leads into the two jacks marked "+" and "COMMON--" and connect the clips to the two sides of the circuit to be checked.

d. Turn on the power and read decibels on the black arc marked "D.B." which is at the bottom of the scale. In order

to obtain decibel readings it is necessary to add algebraically the scale reading and the number shown at the setting of the range selector switch. For example, if the scale indication is -4DB with the switch in the 12DB position, the true reading will be +8DB. (+12-4=+8) (For .001 watt-600 ohm reference add +7 DB)

7. D. C. RESISTANCE MEASUREMENTS.

CAUTION: Before making any resistance measurements in a radio circuit, be sure the current is turned off so that no voltage exists. Otherwise the meter may be damaged.

a. Place the "OUTPUT-A.C.-D.C." switch in the "D.C." position.

b. Rotate the range selector switch to any of the three ranges required.

Rx1 for 0-2000 ohms.

Rx100 for 0-200,000 ohms.

Rx10,000 for 0-20 megohms.

c. Plug the test leads into the two jacks marked "+" and "COMMON--". Short the ends of the leads and set the pointer to zero by rotating the "ZERO OHMS" knob.

d. Separate the ends of the test leads and clip them across the portion of the circuit to be measured.

e. Read ohms on the black arc at the top of the scale.

For range Rx1, read the figures directly.

For range Rx100, multiply the reading indicated by 100 or add two zeros.

For range Rx10,000 multiply the reading indicated by 10,000 or add four zeros.

Example: A 2 megohm resistor should be checked on the Rx10,000 range. The reading on the scale will be 200. Adding four zeros will give 2,000,000 ohms or 2 megohms.

CAUTION: Do not leave the range selector switch in a resistance measurement position when the meter is not in use because the test leads may become shorted and run down the in-

ternal battery. It is also possible that the instrument may be connected across a voltage accidentally and thus cause damage to the meter.

8. CURRENT MEASUREMENTS IN D. C. CIRCUITS.

a. Place the "OUTPUT-A.C.-D.C." switch in the "D.C." position.

b. Rotate the range selector switch to any of the ranges required. WHEN IN DOUBT OF THE CURRENT PRESENT, ALWAYS USE THE HIGHEST RANGE AS A PROTECTION TO THE METER. After obtaining the first reading, the switch can be reset to a lower range if needed.

c. Plug the black test lead into the jack marked "COMMON--" and the red test lead into the jack marked "+". For the 10 ampere range use the jacks marked "-10 A." and "+10 A."

d. Break the circuit to be tested and insert the meter in series by connecting the red test lead to the positive side and the black test lead to the other side.

e. Turn on the power.

f. Read milliamperes on the black arc which is second from the top. If the pointer is forced against the stop at the left of the scale, the connections are incorrect. Turn off the power and reverse the position of the test clips.

For 100 microamperes, read the figures 0-10 and multiply by 10.

For 10 milliamperes read the figures directly.

For 100 milliamperes read the figures 0-10 and multiply by 10.

For 500 milliamperes read the figures 0-50 and multiply by 10.

For 10 amperes read the figures 0-10 directly.

CAUTION: For current measurements, the meter must always be connected in series with the circuit. Never connect the meter across a voltage source when the range selector switch is set for current measurement because this may damage the meter. Always observe polarity.

SECTION III

FUNCTIONING OF PARTS

The complete schematic diagram of the Model 260 volt-ohm milliammeter is shown in Figure 9. The simplified sections are described in the following paragraphs.

1. D. C. VOLTMETER CIRCUIT--20,000 OHMS PER VOLT.

Figure 2 shows the circuit used when the "OUTPUT-A.C.-D.C." switch is in the "D.C." position and the range selector switch is in any one of the five voltage positions.

The total resistance of the bank of multiplier resistors and the meter is 100 megohms or 100,000,000 ohms from the "5000 V." jack to the "NEG." jack. Ohms law will show that when a 5000 volt potential is applied between the two jacks, a current of 50 microamperes will flow through the circuit, causing a full scale deflection of the meter. Dividing the number of ohms, 100,000,000, by the number of volts, 5000, gives 20,000 ohms, which is the sensitivity per volt.

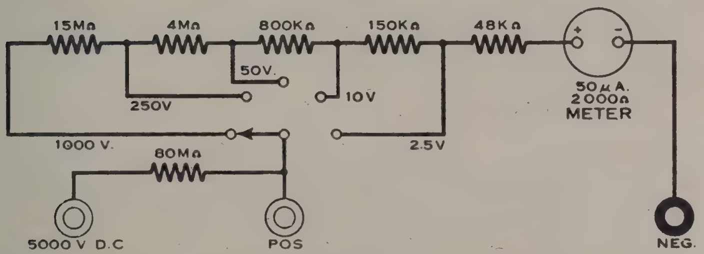


Figure 2 Simplified D.C. Voltmeter Circuit

2. A.C. VOLTMETER CIRCUIT--1000 OHMS PER VOLT.

Figure 3 shows the circuit used when the "OUTPUT-A.C.-D.C." switch is in the "A.C." position and the range selector switch is in any one of the five voltage positions.

In this circuit the A.C. is rectified by a copper oxide rectifier In order to supply the microammeter with direct current. The

other half of the cycle passes around the meter and through the rectifier in the opposite direction as shown by the arrows in Figure 3. The shunt resistor R-24 and the series resistor R-23 are precision wound and calibrated with the rectifier with which they are used. The resulting sensitivity is 1000 ohms per volt.

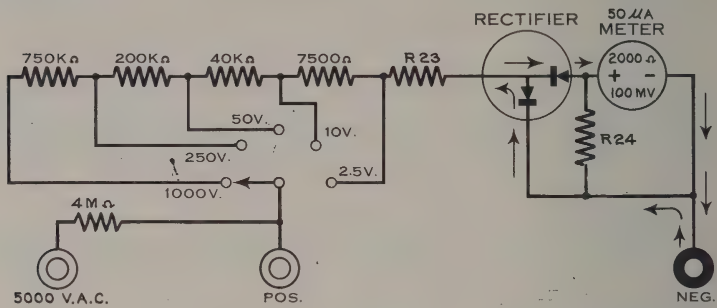


Figure 3 Simplified A.C. Voltmeter Circuit

3. A.F. OUTPUT METER.

Figure 4 shows the circuit used when the "OUTPUT-A.C.-D.C." switch is in the "OUTPUT" position and the range selector switch is in any one of the five voltage positions. This is the same as the A.C. voltmeter except that the 5000 V. range is omitted and a .1 mfd. condenser is placed in series with the "POS." jack to block the D.C. component when connection is made direct to the plate of a tube.

When reading A.C. voltage with the output meter the impedance of the blocking condenser, which is in series with the voltage multipliers, must be taken into consideration. This impedance will cause considerable error at 60 cycles but the percent of error will decrease with an increase in frequency.

The actual effective resistance is equal to $\sqrt{Xc^2+R^2}$ where Xc is the capacitive reactance of the .1 mfd. condenser and R the multiplier resistance.

For the 2.5 volt range R=2500 ohms and Xc at 60 cycles= 26,500 ohms. Therefore $\sqrt{26,500^2+2500^2}$=26,618 ohms, which is the actual effective resistance in the circuit.

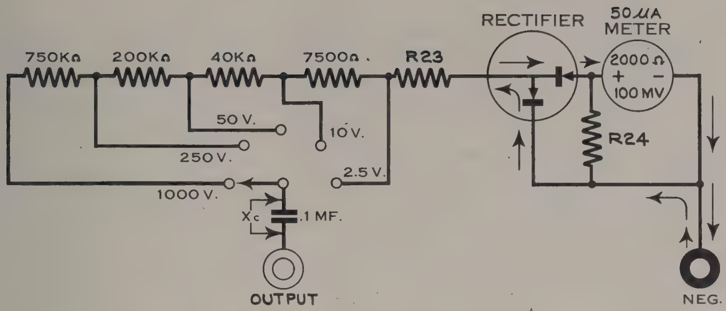


Figure 4 Simplified Output Meter Circuit

4. VOLUME LEVEL METER

The decibel is a unit of measurement used in P.A. and telephone work. Two reference levels are commonly used, .001 watt in 600 ohms for telephone service and .006 watt in 500 ohms for P.A. service. The former establishes the zero reference level at .7746 volts and the latter at 1.732 volts. The Model 260 DB scale is based on the .006 watt-500 ohm level with zero DB at 1.732 volts.

This scale may be converted to the .001 watt-600 ohm level by adding +7DB to the scale indication.

The output meter is more commonly used in radio service work for comparative readings but if desired, A.C. Volts can be converted into decibels by means of a conversion chart. Refer to Section VI--Supplementary Data.

5. D.C. OHMMETER.

Figures 5, 6 and 7 show the ohmmeter circuits when the range selector switch is in positions Rx1, Rx100 and Rx10,000

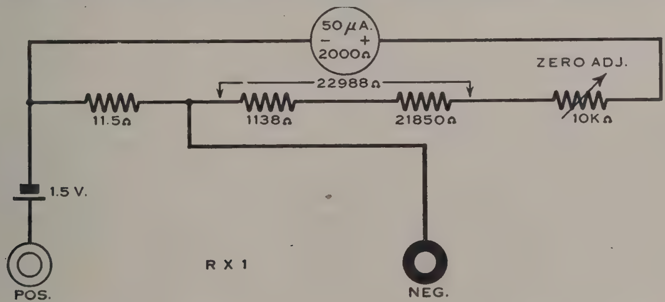


Figure 5 Ohmmeter Circuit with Selector Switch in Position Rx1

respectively. The selector switch throws in the proper series and shunt resistors and batteries for each range so that when the test leads are shorted, the meter will read full scale.

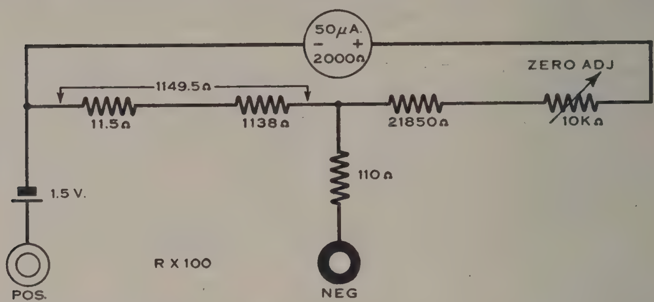


Figure 6 Ohmmeter Circuit with Selector Switcn in Position Rx100

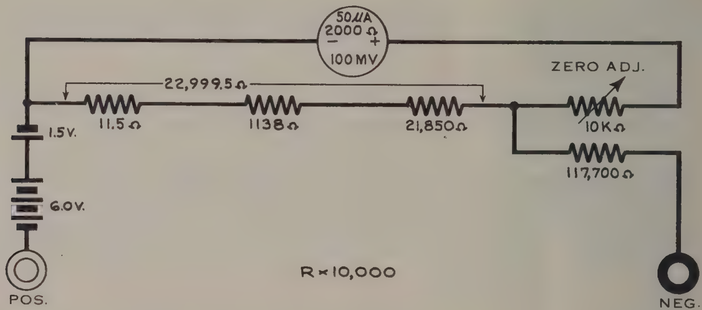


Figure 7 Ohmmeter Circuit with Selector Switch in Position Rx10,000

6. D.C. MILLIAMMETER AND AMMETER.

Figure 8a shows the circuit used when the "OUTPUT-A.C.-D.C." switch is in the "D.C." position and the range selector switch is in the 100 microampere position. This circuit is equivalent to two equal resistors in parallel, the 3000 ohm resistor and 2000 ohm meter forming one 5000 ohm leg and the five resistors between the "POS." and "NEG." terminals forming the other. As a result, when a current of

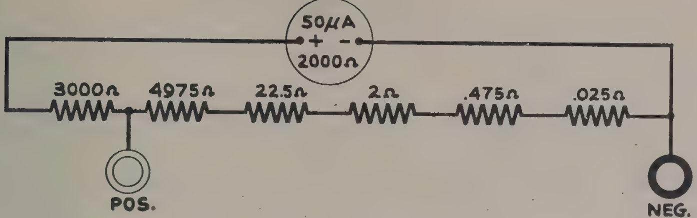


Figure 8a Simplified Microammeter Circuit

100 microamperes is flowing through the circuit, 50 microamperes flow through the shunt resistors and 50 microamperes flow through the meter, causing full scale deflection.

Figure 8b shows the circuit used when the "OUTPUT-A.C.-D.C." switch is in the "D.C." position and the selector switch is in the 10 M.A., 100 M.A. or 500 M.A. positions. It can be seen that the resistance of the shunt resistors becomes lower as the higher current positions are used, thereby permitting a larger amount of current to flow through them. The amount of current flowing through the meter remains at 50 microamperes for full scale deflection. The voltage drop appearing across the various ranges is 250 millivolts.

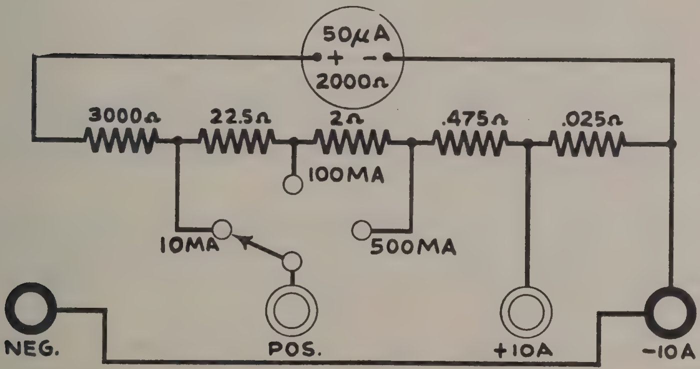


Figure 8b Simplified Milliammeter and Ammeter Circuit

SECTION IV

MAINTENANCE

1. The Model 260 volt-ohm-milliammeter is a very rugged instrument designed to take the wear and tear of every day service work. Nevertheless, care should be taken that the instrument is not dropped or subjected to excessively rough treatment.

2. Always be sure of the character of the circuit to be tested and see that the selectors are properly set before making connections. When in doubt of the amount of voltage or current present, always use the highest range first.

3. BATTERY REPLACEMENT.

Five batteries are mounted inside of the case to provide current for the resistance measuring ranges.

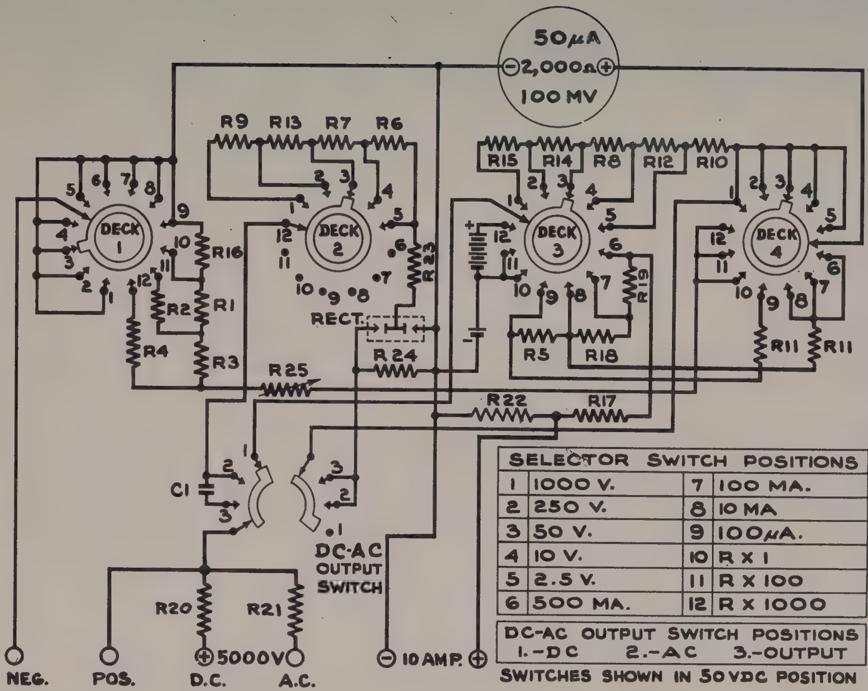
These are:

One Burgess No. 2 Uni-cel . . . . 1.5 V.
or Eveready No. 950 . . . . 1.5 V.
or Ray-o-vac No. 2 . . . . 1.5 V.
or equivalent
Four Burgess No. Z Uni-cel . . . . 1.5 V.
or Eveready No. 915 . . . . 1.5 V.
or Ray-o-vac No. 7R . . . . 1.5 V.
or equivalent

a. When it is no longer possible to bring the pointer to zero on the Rx1 and Rx100 ranges with the test leads shorted and rotating the "ZERO OHMS" knob, the single large 1.5 V. battery should be replaced.

b. When it is no longer possible to bring the pointer to zero on the Rx10,000 range with the test leads shorted and rotating the "ZERO OHMS" knob, the four small 1.5 V. batteries should be replaced.

c. To replace the batteries, remove the instrument from the case. This is done by removing the four screws from the bottom of the case. Slide out the bakelite battery retainers and slip the batteries from between the spring clips holding them in place. Insert the new batteries, being careful that the polarity corresponds to the markings on the bakelite case.



SELECTOR SWITCH POSITIONS			
1	1000 V.	7	100 MA.
2	250 V.	8	10 MA
3	50 V.	9	100μA.
4	10 V.	10	R X 1
5	2.5 V.	11	R X 100
6	500 MA.	12	R X 1000

DC-AC OUTPUT SWITCH POSITIONS
1.-DC 2.-AC 3.-OUTPUT

SWITCHES SHOWN IN 50VDC POSITION

R1	1138 Ω
R2	110 Ω
R3	21,850 Ω
R4	117,700 Ω
R5	4,975 Ω
R6	7500 Ω
R7	40 K Ω
R8	800 K Ω
R9	750 K Ω
R10	48 K Ω
R11	(TWO) 3000 Ω
R12	150 K Ω
R13	200 K Ω
R14	4 M Ω
R15	15 M Ω
R16	11.5 Ω
R17	0.475 Ω
R18	22.5 Ω
R19	2 Ω
R20	80 M Ω
R21	4 M Ω
R22	0.025 Ω
R 23	RECT. SERIES CALIBRATED
R 24	RECT. SHUNT CALIBRATED
R25	10 K Ω POT.
C1	.1 MFD 400 V.

Figure 9 Model 260 Schematic Diagram

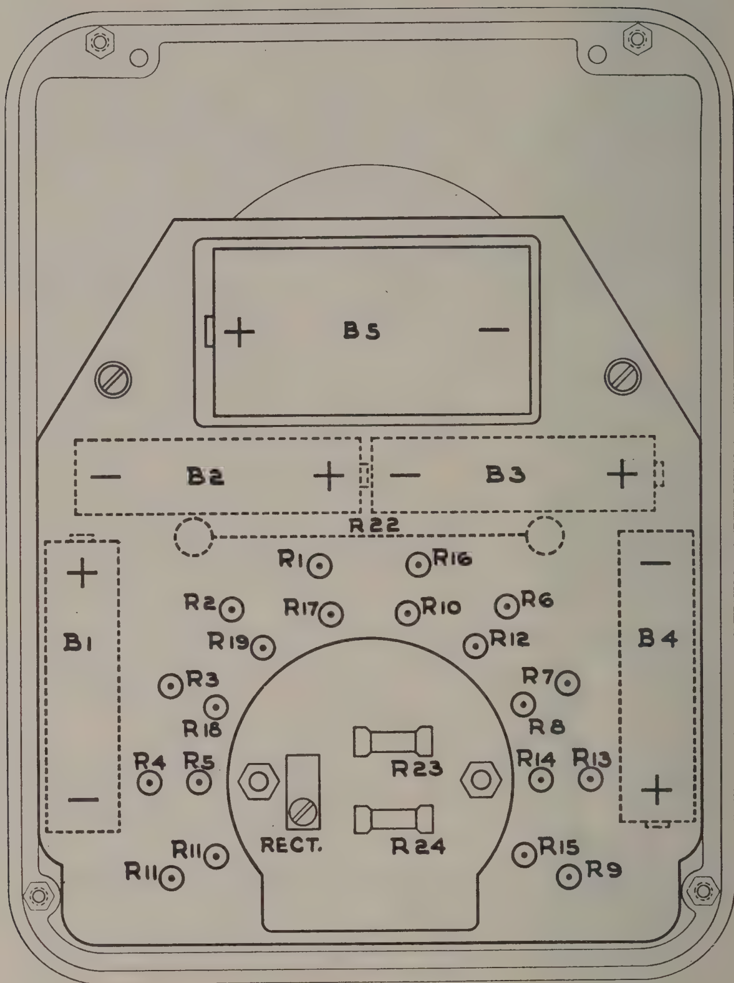


Figure 10a Model 260 Parts Layout--Rear View

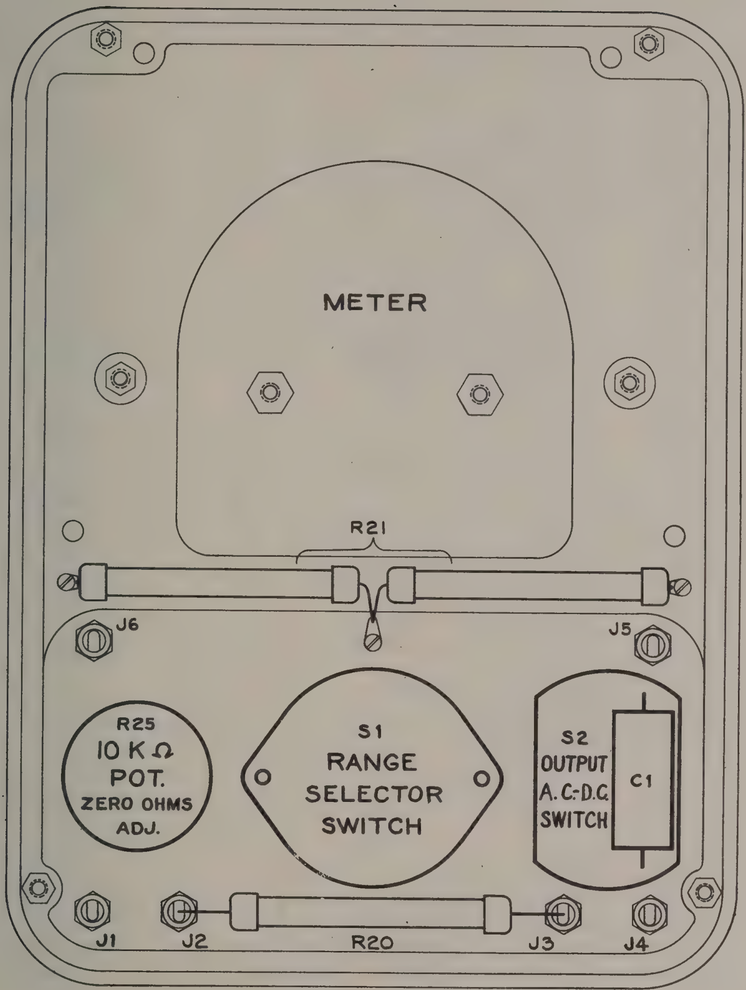


Figure 10b Model 260 Parts Layout--
Rear View of Front Panel

4. PARTS LIST.

Part No.	Description		Reference Symbol
1-113372	1138 ohm resistor		R1
1-113373	110 ohm resistor		R2
1-113369	21850 ohm resistor		R3
1-113367	117700 ohm resistor		R4
1-113371	4975 ohm resistor		R5
1-113370	7500 ohm resistor		R6
1-113309	40000 ohm resistor		R7
1-113363	800000 ohm resistor		R8
1-113364	375000 ohm resistor (2 Required)		R9
1-113368	48000 ohm resistor		R10
1-113287	3000 ohm resistor (2 Required)		R11
1-113366	150000 ohm resistor		R12
1-113365	200000 ohm resistor		R13
1-113362	4 megohm resistor		R14
1-113361	7.5 megohm resistor (2 Required)		R15
0-008070	11.5 ohm resistor (bobbin)		R16
0-008285	.475 ohm resistor (bobbin)		R17
0-008133	22.5 ohm resistor (bobbin)		R18
0-008060	2 ohm resistor (bobbin)		R19
1-113353	80 megohm resistor		R20
1-113352	2 megohm resistor (2 Required)		R21
0-008033	.025 ohm shunt assembly 10 amp. 250 MV-DC		R22
0-008585	Copper oxide rectifier	Calibrated together	Rect.
	Series resistor		R23
	Shunt resistor		R24
1-111722	10000 ohm potentiometer		R25
1-113733	0.1 MFD. 400V. condenser		C1
1-113266	Range selector switch		S1
1-111891	Output-AC-DC switch		S2
1-111728	Jack, pin type		J1-6
1-111802	Dry cell 1.5 volt (4 Required)		B1-4
1-111798	Dry cell 1.5 volt		B5
3-262871	Range selector knob		
1-113641	Zero ohms knob		
1-113642	Output-AC-DC knob		
0-008375	Test lead set		

Part No. Black		Part No. Brown
15-302260	Meter with panel	15-302109
3-320068	Bakelite Case	3-320078
1-113283	Carrying Handle	1-113830
0-005572	Meter Cover with Glass	0-005586
*3-260180	Range Selector Knob	*3-260185
*3-262871	Zero Ohms and Output AC-DC Knob	*3-260186

*For all Models bearing Serial No. 60,000 or above.

Note--When ordering parts, specify serial number appearing on the bottom of the front panel of the Model 260.

SECTION V

APPLICATIONS

The high sensitivity of the Model 260 volt-ohm-milliammeter not only makes it suitable for all of the applications of a low sensitivity meter but also makes it adaptable to many special uses. The following applications are only a few of the many for which you will find the Model 260 a superior instrument.

1. MEASURING GRID CURRENTS.

The Model 260, with its 100 microampere scale is so sensitive that it is possible to measure the grid currents of many tubes. A readable value as low as 1 microampere can be obtained.

2. F.M. ALIGNMENT.

By opening the load resistor circuit of the limiter in a F.M. receiver and inserting the Model 260 as a microammeter in series, a reading may be obtained for I.F. alignment purposes. Adjust the circuit for maximum indication. Manufacturers' alignment instructions should be consulted for exact procedure.

3. A.V.C. DIODE CIRCUITS.

An ordinary low sensitivity meter cannot be used across an A.V.C. network because of the low resistance which alters the constants of the circuits. The Model 260, however, requires so little current that sufficient indication can be obtained to determine if the A.V.C. circuit is functioning.

4. HIGH Mu PLATE VOLTAGE.

High Mu tubes require a high resistance plate resistor. For this reason a low resistance meter will not give a satisfactory reading. Due to the high resistance and low current consumption of the Model 260, it will give a much more accurate indication.

5. BIAS OF POWER DETECTOR.

A power detector uses a high resistance cathode resistor. A high sensitivity meter such as the Model 260 is essential to obtain a reading of the bias voltage on such a tube.

6. MODEL 260 AS A CONDENSER TESTER.

a. Condensers can be roughly tested for shorts and leakage with the Model 260, using the Rx10,000 range. A shorted condenser will cause a large deflection of the pointer of the ohmmeter and a condenser with high leakage will show a partial deflection of the pointer.

Any condenser, other than electrolytic types, will normally cause a slight deflection of the pointer until the condenser becomes charged, when the pointer will return to zero. If the initial deflection is not present, it probably indicates an open lead. The resistance of a good paper condenser should be above 50 megohms per microfarad and that of mica condensers--above 100 megohms per microfarad. This resistance varies inversely according to the size of the condenser, and is so high that it will not register on the ohmmeter.

When testing electrolytic condensers with the ohmmeter, the positive jack should be connected to the positive terminal of the condenser. Otherwise the reading will be too high because of the high leakage in the reverse polarity. After connecting the test leads to the condenser, allow sufficient time for the pointer to reach its maximum resistance reading.

In general, a high grade, high voltage electrolytic condenser should read about .5 megohm or above and a low voltage electrolytic by-pass condenser should read above .1 megohm. A more accurate test is to apply the rated polarizing D.C. voltage to the condenser with a milliammeter in series. It should read about 0.1 ma. per mfd., the maximum for a useful unit being about 0.5 ma. per mfd. New electrolytics that have been idle for considerable time may show high leakage but after "ageing" at their rated voltages for a few minutes will return to normal.

b. A rough test of the comparative capacity of PAPER condensers can be made with the Model 260 by connecting it as shown in Figure 11. The larger the unknown condenser being tested, the smaller its reactance and therefore the higher the reading will be on the A.C. voltmeter.

The chart shows the approximate readings that will be obtained when testing condensers from .001 mfd. to 1.0 mfd.

CAUTION: Before connecting an unknown condenser for test place the range selector switch of the Model 260 in the 250 V. position. Connect the condenser and if it is shorted, the

meter will read line voltage. This would damage the meter if it were in the 10 V. position.

Do not try to test electrolytic condensers in this manner because only D.C. can be applied to them.

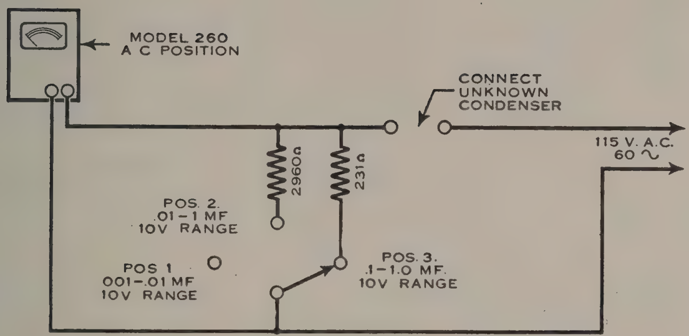


Figure 11 Model 260 Used as Condenser Tester

UNKNOWN CONDENSER MFD.	METER RANGE	APPROXIMATE READING A.C. VOLTS	
.001	10 V. A.C.	.6	Pos. 1 Figure 11
.002	” ”	1.1	
.003	” ”	1.5	
.004	” ”	1.9	
.005	” ”	2.5	
.006	” ”	3.0	
.007	” ”	3.6	
.008	” ”	4.0	
.009	” ”	4.4	
.01	” ”	4.8	
.01	10 V. A.C.	1	Pos. 2 Figure 11
.02	” ”	2	
.03	” ”	3	
.04	” ”	4	
.05	” ”	5	
.06	” ”	6	
.07	” ”	7	
.08	” ”	8	
.09	” ”	9	
.1	” ”	10	
.1	10 V. A.C.	1	Pos. 3 Figure 11
.2	” ”	2	
.3	” ”	3	
.4	” ”	4	
.5	” ”	5	
.6	” ”	6	
.7	” ”	7	
.8	” ”	8	
.9	” ”	9	
1.0	” ”	10	

SECTION VI

SUPPLEMENTARY DATA

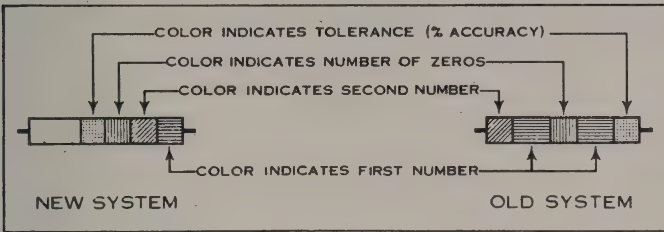


Figure 12 RMA Resistor Color Code Chart

1. RMA RESISTOR COLOR CODE CHART.

Color	Number	Color	Number
Black	0	Green	5
Brown	1	Blue	6
Red	2	Violet	7
Orange	3	Gray	8
Yellow	4	White	9

Gold (green-old system)........... 5% tolerance

Silver (blue-old system) .... 10% tolerance

None .... 20% tolerance (Standard)

EXAMPLE: A 50,000 ohm resistor of standard tolerance is indicated by a green ring (5), a black ring (0) and an orange ring (000) as shown in the new system of marking in Figure 12. In the old system of marking, at the right of Figure 12, the resistor would be painted green (5) with a black end (0) and an orange dot or ring in the center (000).

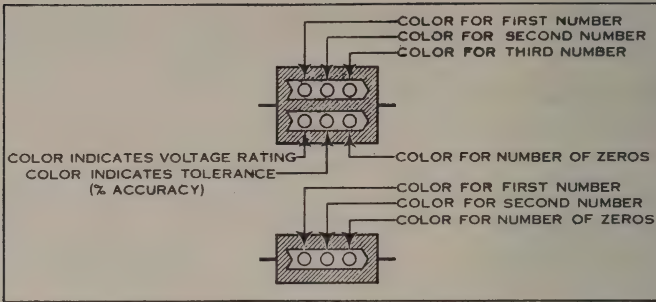


Figure 13 RMA Mica Capacitor Color Code Chart

2. RMA MICA CAPACITOR COLOR CODE CHART.

Color	Number	Tolerance	Voltage Rating
Black	0		——
Brown	1	1%	100
Red	2	2%	200
Orange	3	3%	300
Yellow	4	4%	400
Green	5	5%	500
Blue	6	6%	600
Violet	7	7%	700
Gray	8	8%	800
White	9	9%	900
Gold		5%	1000
Silver		10%	2000
None		20%	500

EXAMPLE: A 56,300 MMFD.(0.0563 MFD.) capacitor of 10% tolerance and a 500 volt rating is indicated by a green dot (5), a blue dot (6), and an orange dot (3), on the top row; a red dot (2 zeros) (00), a silver dot (10% tolerance) and a green dot (or no color) (500 volts) arranged in the order shown in Figure 13. All capacitance values are given in micro-microfarads (MMFD). To convert to microfarads (MFD) move the decimal point 6 places to the left. Small capacitors are often marked with 3 dots as shown in Figure 13. For example, a 250 MMFD. unit (.000250 MFD.) would be marked Red (2), green (5), and brown (1 zero) (0).

The RMA Condenser marking code is in wide use, although there will be some cases where other codes will be found.

3. DECIBELS ABOVE AND BELOW REFERENCE LEVEL EXPRESSED IN WATTS AND VOLTS.

Reference level 6 milliwatts into 500 ohms

Note that the power in watts holds for any impedance, but the voltage holds only for 500 ohms.

DB. Down Volts	DB. Down Watts	Power Level − +	DB. Up Volts	DB. Up Watts
1.73	6.00×10^{-3}	0	1.73	.00600
1.54	4.77×10^{-3}	1	1.94	.00755
1.38	3.87×10^{-3}	2	2.18	.00951
1.23	3.01×10^{-3}	3	2.45	.0120
1.09	2.39×10^{-3}	4	2.75	.0151
.974	1.90×10^{-3}	5	3.08	.0190
.868	1.51×10^{-3}	6	3.46	.0239
.774	1.20×10^{-3}	7	3.88	.0301
.690	9.51×10^{-4}	8	4.35	.0387
.615	7.55×10^{-4}	9	4.88	.0477
.548	6.00×10^{-4}	10	5.48	.0600
.488	4.77×10^{-4}	11	6.15	.0755
.435	3.87×10^{-4}	12	6.90	.0951
.388	3.01×10^{-4}	13	7.74	.120
.346	2.39×10^{-4}	14	8.68	.151
.308	1.90×10^{-4}	15	9.74	.190
.275	1.51×10^{-4}	16	10.93	.239
.245	1.20×10^{-4}	17	12.26	.301
.218	9.51×10^{-5}	18	13.76	.387
.194	7.55×10^{-5}	19	15.44	.477
.173	6.00×10^{-5}	20	17.32	.600
.0974	1.90×10^{-5}	25	30.8	1.90
.0548	6.00×10^{-6}	30	54.8	6.00
.0308	1.90×10^{-6}	35	97.4	19.0
.0173	6.00×10^{-7}	40	173	60.0
.00974	1.90×10^{-7}	45	308	190
.00548	6.00×10^{-8}	50	548	600
.00173	6.00×10^{-9}	60	1,730	6,000
.000548	6.00×10^{-10}	70	5,480	60,000
.000173	6.00×10^{-11}	80	17,300	600,000

4. CAPACITATIVE REACTANCES (Correct to three significant figures.)

a. AUDIO FREQUENCIES

$$\text{Formula: } Xc = \frac{1}{2\pi f c}$$

Capacitance Microfarads	Reactance in ohms at: 30 c/s	60 c/s	100 c/s	400 c/s	1000 c/s	5000 c/s
.00005	—	—	—	—	—	637,000
.0001	—	—	—	—	1,590,000	318,000
.00025	—	—	—	1,590,000	637,000	127,000
.0005	—	—	3,180,000	796,000	318,000	63,700
.001	—	2,650,000	1,590,000	398,000	159,000	31,800
.005	1,060,000	530,834	318,000	79,600	31,800	6,370
.01	531,000	265,000	159,000	39,800	15,900	3,180
.02	263,000	132,500	79,600	19,900	7,960	1,590
.05	106,000	53,083	31,800	7,960	3,180	637
.1	53,100	26,500	15,900	3,980	1,590	318
.25	21,200	10,584	6,370	1,590	637	127
.5	10,600	5,308	3,180	796	318	63.7
1	5,310	2,650	1,590	389	159	31.8
2	2,650	1,325	796	199	79.6	15.9
4	1,310	663	398	99.5	39.8	7.96
8	663	332	199	49.7	19.9	3.98
16	332	166	99.5	24.9	9.95	1.99
25	212	106	63.7	15.9	6.37	1.27
35	152	86	45.5	11.4	4.55	.910

b. RADIO FREQUENCIES

$$\text{Formula: } Xc = \frac{1}{2\pi f c}$$

Capacitance Microfarads	Reactance in ohms at: 175 Kc/s	252 Kc/s	465 Kc/s	550 Kc/s	1000 Kc/s	1,500 Kc/s
.00005	18,200	12,600	6,850	5,800	3,180	2,120
.0001	9,100	6,320	3,420	2,900	1,590	1,060
.00025	3,640	2,530	1,370	1,160	637	424
.0005	1,820	1,260	685	579	318	212
.001	910	632	342	290	159	106
.005	182	126	68.5	57.9	31.8	21.2
.01	91.0	63.2	34.2	28.9	15.9	10.6
.02	45.5	31.6	17.1	14.5	7.96	5.31
.05	18.2	12.6	6.85	4.79	3.18	2.12
.1	9.10	6.32	3.42	2.89	1.59	1.06
.25	3.64	2.53	1.37	1.16	.637	.424
.5	1.82	1.26	.685	.579	.318	.212
1	.910	.632	.342	.289	.159	.106
2	.455	.316	.171	.145	.0796	.0531
4	.227	.158	.0856	.0723	.0398	.0265

Quality is the indispensable component
of every Simpson instrument . . . . . .